

## Pesticides Project Progresses while the Peace Process Stalls

Each summer, backyard gardeners across the United States turn over the leaves on their young tomato plants to check for whiteflies. These tiny pests attack the undersides of the leaves, where they feed on sap and often introduce viruses that weaken or kill the plant. In heavily infested gardens, clouds of whiteflies will swirl in swarms when the plants are shaken. At this stage, they have become difficult to control and the gardener is likely to find them attacking most other fruits and vegetables in the garden.

While the whitefly is annoying to backyard gardeners, it is devastating to farmers whose livelihoods depend on abundant and healthy harvests. Strains of whitefly (*Bemisia tabaci*, *B. argentifolii*) are found throughout the world and are prevalent across the Middle East. Although known to attack over 500 types of plants, the whitefly favors cotton, Egypt's largest export, and thrives on tomatoes, melons, cucumbers, and citrus fruits—all produced throughout the Middle East for local consumption and export. The whitefly also feeds on ornamental flowers, a particularly lucrative export from the Palestine Territories and Israel. Unfortunately, the whitefly is developing increased resistance to commonly used chemical pesticides such as pyrethroids and organophosphates. Consequently, farmers are applying more of these pesticides and using other, more powerful, broad-spectrum compounds. Such methods increase production costs, induce further chemical resistance, and increase the potential for harm to workers' health and the environment.

In August 1997, Ronald Oetting, professor of entomology at the University of Georgia in Griffin, visited Israel, Jordan,

and the Palestinian West Bank on behalf of the Project on the Safe and Effective Use of Pesticides, coordinated by the NIEHS and the U.S. Department of Agriculture (USDA). Following the signing of the Oslo Peace Accords in December 1993, the NIEHS was asked by the U.S. Department of State to coordinate a regional program to reduce exposures to pesticides in farmers, farm families, and other agricultural workers in Egypt, Jordan, Israel, and the Palestine Territories as part of the Multilateral Middle East Peace Process.

Oetting, who advised farmers on the effective use of pesticides, a critical part of the project, reports, "We got an early start visiting fields with whitefly and pink bollworm problems. The cotton fields were being defoliated and the air was full of flying whiteflies. It reinforced the theory that nations need to cooperate. It is obvious that the whiteflies were going somewhere, and that 'somewhere' is where the wind blows them, probably down the Jordan River Valley, back and forth across the borders. We predict the whitefly will end up in Jordan for the winter crops and return to Israel and the West Bank Territories for the summer crop."

The whitefly is only one of many pests in the Middle East. The growing season there is relatively long, and farm families and large growers have developed a strong agricultural economy. But wherever crops can be induced to grow, farmers must still constantly battle pests including insects, worms, slugs, rodents, fungi and molds, bacteria, and viruses in their fields and greenhouses. Agricultural chemicals have been critically important to the advancement of agricultural self-sufficiency in the Middle East, but their value in fertilizing marginally arable soils and protecting crops from predators is being questioned

by consumers who now demand safer foods. Also, increasingly stringent restrictions are being placed on pesticide residues for foods, fibers, and flowers from the region, further limiting farmers' access to export markets.

Farmers in the region are now shifting from field farming to greenhouse and screenhouse farming to control the growing environment and to limit pest access to their crops.

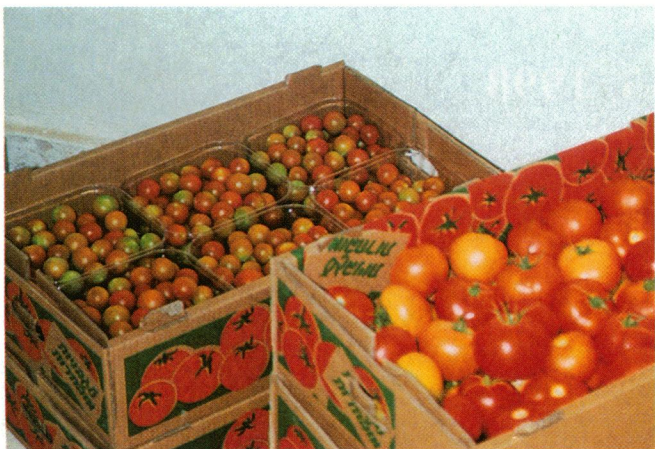
In an experimental screenhouse at the Arab Development Project in Jericho in the Palestinian West Bank Territory, project experts are growing tomatoes with minimal use of pesticides. Marketed as "low pesticide" produce, the tomatoes are in high demand in local markets and bring a premium price. However, in the more typical greenhouses and screenhouses found in the region, pests find their way inside through faults in the construction and directly through the doors and vents. Pesticide usage is also not significantly reduced. Experts in worker safety have observed that pesticide exposures are actually more dangerous in these facilities, where pesticide concentrations are higher than in the field and where the most important route of exposure is through inhalation rather than dermal absorption.

Kamal Abdo, a research toxicologist at the NIEHS and the project's director, says, "The underlying concepts of the Middle East peace process and the Project on the Safe and Effective Use of Pesticides are that nations in the region must work together to address their problems, including agricultural, health, and environmental problems. This project is helping to implement the Middle East peace process, one of the highest foreign policy priorities of the United States. And it shows how a science-based program can protect human health and the environment, while creating substantial economic benefits by increasing crop production and decreasing production costs, all factors that contribute to peace and stability in the region and the world. This is a perfect example of the benefit of the rational application of scientific research."

## The Peace Process

As recently as the summer of 1993, the notion of assembling Palestinians, Israelis, Jordanians, and Egyptians to work together for a common purpose in the region was unrealistic. Egypt and Israel had agreed to peace and cooperation at Camp David but Jordan was still officially at war with Israel. In fact, in 1993 it was impossible to make an international telephone call from Amman, Jordan, to Jerusalem, only 50 miles away. Security controls made travel within the area difficult, if not impossible, for average citizens.

The Oslo Accords made cooperation among Egypt, Israel, Jordan, and the Palestinian Territories truly possible. Under the accords, Israel would cede control of the Gaza Strip and parts of the West Bank to the Palestinians and a whole range of previously nonnegotiable differences



**Less is more.** At the Arab Development Project in Jericho, tomatoes are being grown in an experimental screenhouse using minimal pesticides.

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would be put on the table for discussion and resolution according to an agreed-upon timetable. The accords were meant to provide a pathway to lasting peace among the Palestinians, Israelis, and Jordanians, but immediate actions were needed to demonstrate tangible benefits from peace. Therefore, the governments agreed to collaborate in five areas of common concern: regional economic development, water resources, refugees, arms control, and the environment.

Coincidentally, when the Oslo Accords were announced, NIEHS staff were attending a meeting in Cairo, Egypt, where health and environmental protection experts from the United States and across the Middle East had gathered to discuss environmental hazards and responses. The experts from the region expressed frustration with the dangerous levels of human exposure to heat, dusts, and air pollutants, the lack of safe drinking water in rural areas, and inadequate hazardous and solid waste management services. They noted that national leaders could not give priority to these kinds of problems when faced with more pressing concerns for national security and economic independence. This meeting had been convened by Claire Hubbard, then regional program manager for Africa and the Middle East for the National Institutes of Health's Fogarty International Center. Hubbard had traveled throughout the Middle East, observing firsthand the effects of environmental pollution on human health. Says Hubbard, "As an American scientist able to travel from country to country in the region, I knew that there was a small but dedicated group of experts in each country who recognized that environmental exposures were having a serious impact on public health. Unfortunately, because of the political tensions, none of them knew about potential allies just a few miles away with similar concerns. I had hoped that a regional meeting to exchange ideas on evaluation of the relative risks of various environmental exposures would help them focus their individual work."

Terri Damstra, former director of international programs at the NIEHS, led the institute's delegation to the Cairo meeting. Upon returning to the United States, Damstra wrote to Jonathan Margolis at the Bureau of Oceans and International Environmental and Scientific Affairs at the U.S. Department of State to request support for a second meeting of Middle East environmental health experts to plan collaborative health research projects. Margolis believed he had a better idea.

Knowing that the environment was targeted for multinational projects under the Middle East peace process, Margolis asked the NIEHS to draft a proposal for a project that could begin quickly. According to Margolis, "The NIEHS proposal [for a second meeting] made sense from a scientific point of view but I thought it premature. Before such cooperative research could begin, it would be necessary to build the infrastructure for collaboration. I asked the NIEHS to design a project that would enable regional scientists to routinely communicate among themselves, to plan their own projects, and to set their own priorities."

### Assessing the Situation

There had been extensive discussion at the Cairo meeting about the economic importance of agriculture, the heavy dependence on agricultural chemicals in crop and fiber production, and the potential threats such chemicals pose to health and the environment in the region. Consequently, NIEHS staff outlined a proposal to reduce exposures to agricultural chemicals among farmers, farm workers, and their families, and the U.S. Department of State organized a meeting of technical experts from Egypt, Israel, Jordan, and the Palestine Territories to discuss its feasibility. At a December 1994 meeting, also held in Cairo, the NIEHS project outline was enthusiastically adopted by the regional experts, and the discussion focused on specific details. Most importantly, the experts agreed that a communications system that would allow a continuous exchange of information and ideas was necessary. The experts agreed to pursue broad general goals in communications, data collections and data sharing on agricultural chemical usage and human and environmental monitoring, planning and evaluation of small pilot projects to monitor exposure and reduce human exposures, and research as well as research training. They agreed to work as a team to develop specific activities to meet these goals and to assign priorities among the activities.

Eileen Herrera, international programs specialist at the international cooperation



**Meeting of the minds.** Technical experts on the project are (top row, l-r) Madi Jaghabir, Jordan; Eileen Herrera, USDA; Nabila Bakry, Egypt; (middle row, l-r) Bakir Oteifa, Egypt; Dan VanderMeer, NIEHS; Sameer Abu-El-Haj, Palestine; Kamal Abdo, NIEHS; Shlomo Capua, Israel; (bottom row, l-r) Jamal Safi, Palestine; Dennis Kopf, USDA.

and development office of the USDA Foreign Agricultural Service, had been invited to the second Cairo meeting by the U.S. Department of State because of her experience in instituting cooperative projects in the Middle East. Herrera immediately realized the benefits that would accrue from a regional approach to integrated pest management (IPM). IPM is an approach to pest control that depends on the early identification of insects and other pests and careful selection and application of pest control methods, including both appropriate pesticide selection and application methods and the use of nonchemical biological and mechanical controls. Herrera realized that the small arable growing areas in the region were intensively farmed to make them as productive as possible and were also split by international borders, two factors that would have an effect on the success of IPM in the region. Says Herrera, "Heavy use of pesticides in one area could cause pest resistance to develop. These resistant insects could cross [borders]." Herrera offered her expertise and assistance to the NIEHS and the regional experts. "Because I was just beginning IPM programs in the Middle East, it was apparent that shared experiences would enhance local programs. Linking my efforts to the NIEHS [project] made common sense to me," she says.

### Successful Talks

Within a year of the second Cairo meeting, the Project on the Safe and Effective

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Use of Pesticides was under way. The first step was to quickly take advantage of the increasing availability of telephone and other electronic communications in the area, and to exploit the burgeoning Internet system. Each technical expert assigned to the project received a personal computer, printer, and modem with identical communications, technical information management, and word processing software. Dedicated telephone lines were acquired. Within a matter of months, each technical expert was routinely communicating within the region and with NIEHS and USDA staff in the United States via telephone and the Internet.

This was an enormously important accomplishment. When the project was first proposed, none of the regional experts knew of the others' existence, none had access to the Internet, and direct international telephone service was not available. According to Nabila Bakry, professor of pesticide toxicology at Egypt's University of Alexandria and a project scientist, the establishment of a communications system is the most important single accomplishment of the project to date. "By acting as a group of experts in the region, we have been able to exchange important information on regional problems and data on pesticide use in the different countries, and we [can] jointly plan our monitoring and intervention projects. We all know now that pesticides that were extensively used in the past and are now prohibited may continue to pose environmental and health dangers, and that current agricultural practices must be improved."

In planning the Project on the Safe and Effective Use of Pesticides, the senior technical experts from the Middle East region looked far into the future to estimate what resources will be needed as the peace process continues and national priorities shift to regional and national economic development. They agreed that agricultural and industrial development will expand at a much greater rate and that development is likely to put even greater stress on the fragile environmental systems and public health services. They agreed on the goal of sustainable development, and that good scientific and technical leadership can foster such development.

Existing universities in the Middle East have been growing, and in recent years new academic institutions have been established, particularly in Jordan and the Palestinian Territories. At Bir Zeit University in Ramalla in the West Bank, the center for environmental and occupational health trains undergraduate and graduate students, and has developed special continuing education classes for individual farmers and farm families and for large communal and corporate growers. The center has tailored training programs to the culture, language, and educational levels of farm workers in the Palestinian Territories. Tools used in training include a poster developed to depict safe and unsafe handling of pesticides. Training is also offered to Palestinian migrant workers employed on many of the kibbutzim in Israel. Encouraging the use of protective clothing and equipment by such workers, who wear traditional

multilayered dress even in intense heat, presents a difficult challenge.

Professor Sameer Abu-El-Haj has been with the center since its inception and now coordinates the Palestinian activities in the Project on the Safe and Effective Use of Pesticides. Abu-El-Haj urged the project to help create training opportunities for young scientists in environmental and occupational health sciences and encourages his students to take advantage of such opportunities. For example, in August 1997, Aqel Abu-Qare, an assistant professor at the center, began a Fulbright Scholarship at Duke University Medical Center in Durham, North Carolina, with M.B. Abou-Donia in the department of pharmacology. After studying neurotoxicology at Duke, Abu-Qare will return to the West Bank to begin a career in environmental health sciences. Abu-Qare says, "I decided to make a significant career change after learning about the need to expand the scientific basis for environmental public health policies and environmental protection regulation in the Palestinian Territories as they become increasingly autonomous. Through my association with the Safe Use of Pesticides project, I also see the benefits of a regional approach to setting these priorities. While each nation must respond to its own needs and priorities, at the same time there is a need to harmonize our efforts whenever practical."

### Progress in the Project

Abu-Qare's decision to work in the field of environmental public health in the Palestinian Territories begins to fill the need for technical and scientific expertise that will be necessary to remedy the serious environmental contamination being documented throughout the region. Regional experts have been amassing evidence that, in addition to pests such as the whitefly migrating back and forth across borders, it is very likely that pesticides are blown with dusts and fertilizer runoffs flow in waters that cross borders so that they are inhaled and ingested by people throughout the region. The goal of the Project on the Safe and Effective Use of Pesticides is to evaluate the extent of the dispersion of pesticides and reduce human and environmental exposures while maintaining crop productivity and the benefits of agriculture to farmers and the regional economy.

During the 1997 growing season, monitors were placed in and around the fertile fields of the Jordan River Valley about 20 miles south of the Sea of Gallilee. Identical monitors were also placed around fields in three farming areas in the Nile



**Fighting tradition.** Workers such as these Palestinian workers on a kibbutz in Israel are at the greatest risk of exposure to pesticides because the heat and traditional clothing make it difficult to implement the use of protective equipment.

Delta in northern Egypt. The monitors were positioned to capture dust and air in and around fields where agricultural chemicals are being used. In Israel they were also put along farm roads and in areas where farm families live. Dusts contaminated with pesticides applied during the growing season were found in each of the tested areas. This was expected as a certain amount of drift of pesticides away from the target crops is not unusual. As the project progresses, improved spray practices will be implemented and newly emerging spray technologies, including improved nozzles, will be introduced to place the spray directly on the target pest. The dust and air monitoring will continue and will determine the effectiveness of reductions in off-field drift in reducing human and environmental contamination.

The air and dust monitoring also produced surprising information of potential concern. A subset of the samples was tested for a spectrum of agricultural chemicals to determine whether pesticides other than those being sprayed on the fields could be found. The preliminary screening identified at least 15 such substances. Most were organochlorine compounds not currently used by farmers in the area. Among these were DDT and its metabolites, lindane, and 2,4,5-T, all of which are banned or restricted worldwide. Shlomo Capua, director of the Israel division of agroecology and a senior technical expert on the project, says, "We strongly believe that air current and dusts may be the main vehicles of environmentally persistent pesticides migrating significant distances across international borders. . . . We realize that these risks do not respect borders and in many cases must be minimized through joint and coordinated efforts."

Madi Jaghabir, associate professor at the University of Applied Sciences in Amman and the coordinator of the project's health-related activities in Jordan, suspects that human exposures to agricultural chemicals may be a problem in cities as well as in the rural areas in the Middle East. In fat samples from persons undergoing surgery in hospitals in Amman, Jaghabir has found DDT metabolites, lindane, heptachlor, cyclodienes, and other hazardous substances. These are preliminary findings and Jaghabir is careful not to

attribute them to consumption of foods. However, in a survey of pesticide residues conducted last year by the Royal Scientific Society of Jordan, these same compounds were found in about 30% of fruits, vegetables, meats, and dairy products collected from markets in Amman. Of the positive samples, 3% exceeded permissible levels established by the World Health Organization. The Royal Scientific Society survey will be published in 1998 along with the findings of a pesticide residue survey conducted concurrently in Israel.

In another experiment done by Jaghabir under the project, cholinesterase levels were compared in students from farming regions with students from cities, and in groups of farm workers and families during and after spraying operations. Jaghabir consistently found significant decreases in cholinesterase in people with greater opportunities for exposure. Cholinesterase, an enzyme involved in nerve function, is reduced or depleted as a result of exposure to organophosphate- and carbamate-based pesticides. Cholinesterase inhibition is a standard test for organophosphate and carbamate exposure because,

while these compounds have high acute toxicity, they do not accumulate in fat and other tissues. The baseline data on pesticide exposures collected by Jaghabir and others in the region strongly suggest that agricultural chemicals must be used more safely and effectively. Jaghabir shares with Capua and the other technical experts working on the project the belief that this goal can best be achieved through regional cooperation to improve the knowledge and skills of farm workers in the safe use of agricultural chemicals.

Thus far, the Project on the Safe and Effective Use of Pesticides has been successful in continuing to make progress on its objectives through both the tense early days of the collaborations and the recent disruption to the peace process by political, economic, and territorial disagreements at the highest level, and by episodic violence. Abdo says, "The project continues at the local level and the regional technical experts have been implementing ambitious plans for small, local pilot efforts to continue and expand

health and environmental monitoring, interventions to reduce exposure, and expanded and improved IPM activities." Herrera says, "We have learned from the project officer at the U.S. Agency for International Development that their external review panel has recommended funding of a grant proposal submitted by the NIEHS and USDA to continue and expand the Project on the Safe and Effective Use of Pesticides for three years, beginning in early 1998. Clearly there is optimism at all levels that partnerships among technical experts in the Middle East will translate into better health, more productive agriculture, and a safer environment."

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**Sign of the times.** As one part of the project, a poster was designed to teach small-scale farmers and their families the safe use of pesticides.